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Fattening of Mangrove Crab *Scylla serrata* Fed with Two Different Diets (Stingray and Trash Fish)

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ABSTRACT

Fattening of mangrove crab *S. serrata* has been practiced in the Philippines and is considered ecologically sustainable. Trash fish is one of the best natural foods for fattening crab cultures. Meanwhile, stingray also contains plentiful proteins; however, they are not economically valuable in the southern Philippines, causing them to be discarded by most people owing to their unpleasant taste. Considering this, this study aimed to determine the effects of two different diets on mangrove crab fattening using modified plastic cages in mangroves. The experiment was conducted at Sitio Sindang, Indanan, Sulu, Philippines, for 30 days fattening period. Adult crabs (n=12) weighing 100 to 110 grams were reared in modified plastic cages measuring 17 cm x 24.5 cm x 6 cm. Plastic cages were partitioned into six compartments; each contained one crab. Two types of experimental feed, namely: stingray (*Taeniura* sp.) (chopped stingray) as Treatment 1 and trash fish (*Sardinella* sp.) (entrails of fish and chopped trash fish) as Treatment 2, were given to the experimental crabs. The amount of feed given to the crab was calculated based on the 10% body weight. The result showed that the use of stingrays as a source of feed was significantly higher ($p>0.05$) in the weight of mangrove crabs during the early ten days; however, the superiority disappeared after 30 days. Both treatments did not significantly ($p<0.05$) affect the survival performance of mangrove crabs. In addition, the specific growth rate of Treatment 1 ($0.25 \pm 0.20\%$ day^{-1}) was significantly different than Treatment 2 (-0.70 ± 0.27 % day^{-1}) after 30 days. During the experiment, some uncontrollable factors, such as cheliped disintegration, were encountered that may have influenced the outcome, which reduced crab weight. Thus, this study suggests that stingrays might be useful as a source of food for the fattening of mangrove crab *S. serrata*. However, future studies are needed to validate the study's results.

KEYWORDS: Fattening, mangrove crab, modified plastic cage, *Scylla serrata*

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1. Introduction

The fattening mangrove crab has been practiced in Southeast Asia for a long time, and it is considered to be ecologically sustainable (Mirera, 2011). This method has been established by the private sector primarily to meet the demands of the domestic and foreign markets by culturing marketable crabs in a short period (Samarasinghe et al., 1991). In some private sectors, crabs are fattened for 15 to 20 days for consumers to enjoy the meat of large male pincers and the bright red roe of gravid females (Triño and Rodriguez, 2001). In recent years, the mangrove crab *S. serrata* has been considered one of the most promising aquaculture species due to its rapid growth (Rodriguez et al., 2007; Ye et al., 2011; Meng et al., 2017; Wan Yusof et al., 2019). However, in the domestic market, mangrove crabs (*S. serrata)* command a relatively low price as they are harvested even in underweight size, which contributes to the low demand and rejection in the export market (Triño and Rodriguez, 2001). In the early 2000s, mangrove crabs were cultured in pots, bamboo, and cages as part of an experimental program (Khatun, 2007). In shallow lagoons of Bangladesh and coastal waters of India, bamboo cages and pens are used, as well as galvanized wire netting and polyethylene netting for mangrove crab fattening (Cholik and Hanafi, 1991). In the Philippines, fattening crabs in bamboo and net cages and pens has become a means of providing an alternative livelihood for fishers (Kuntiyo, 1992; Triño and Rodriques, 2002). In aquaculture, mangrove crab species, such as *S. serrata, S. oceunica, S. transquebarica, and S. paramamosai*, are edible and commercially produced both in the wild and in cultivation (Susanto et al., 2015). The majority of their commercial production is sent live to market, making them one of the world's most valuable crab species (Shelley and Lovatelli, 2011). The majority of the early mud crab, also known as mangrove crab farming, demonstrations were conducted in Asia and Africa using trash fish, clam meat, or animal by-products as feeds (Fitzgerald, 2002; David and Abdhallah, 2009; Hairol et al., 2022).

The term 'trash fish' refers to fish caught in fisheries that are not economically valuable, including uneatable low-value marine fish and juveniles that would have been discarded by most people (Kasthuri et al., 2021). The use of trash fish as a "standard food" for fattening crabs has been widespread in crab culture enterprises since it is considered one of the best natural foods (Bunlipatanon et al., 2014). Since trash fish are a great source of protein and other nutrients, they could supplement livestock feeds to meet nutritional requirements (Kasthuri et al., 2021). In Indonesia, the stingray is one of the most popular and acceptable species of fish to be smoked, especially when it is processed in the traditional manner (Swastawati et al., 2012). In addition, as stingrays are not economically valuable in the southern Philippines, they are usually discarded due to their unpleasant taste and smell. Although stingrays are not highly-priced compared to other commercial marine fish in the local market, they contain high protein and other nutrients (Uddin et al., 2018). Moreover, there have been few studies examining the use of stingrays in the diet of mangrove crabs. Considering the above-mentioned information, this study aimed to examine the growth of fattened mangrove crab *S. serrata* fed two different diets (stingray (*Taeniura* sp.) and trash fish (*Sardinella* sp.)) in an individual chamber of modified plastic cages in order to avoid predation submerged in mangrove areas of Sitio Sindang Indanan Sulu, Philippines.

2. Materials and Methods

2.1. Study Site and Duration

The study was conducted along the mangrove areas of Sitio, Sindang Indanan Sulu, Southern Philippines (Figure 1) for 30 days.

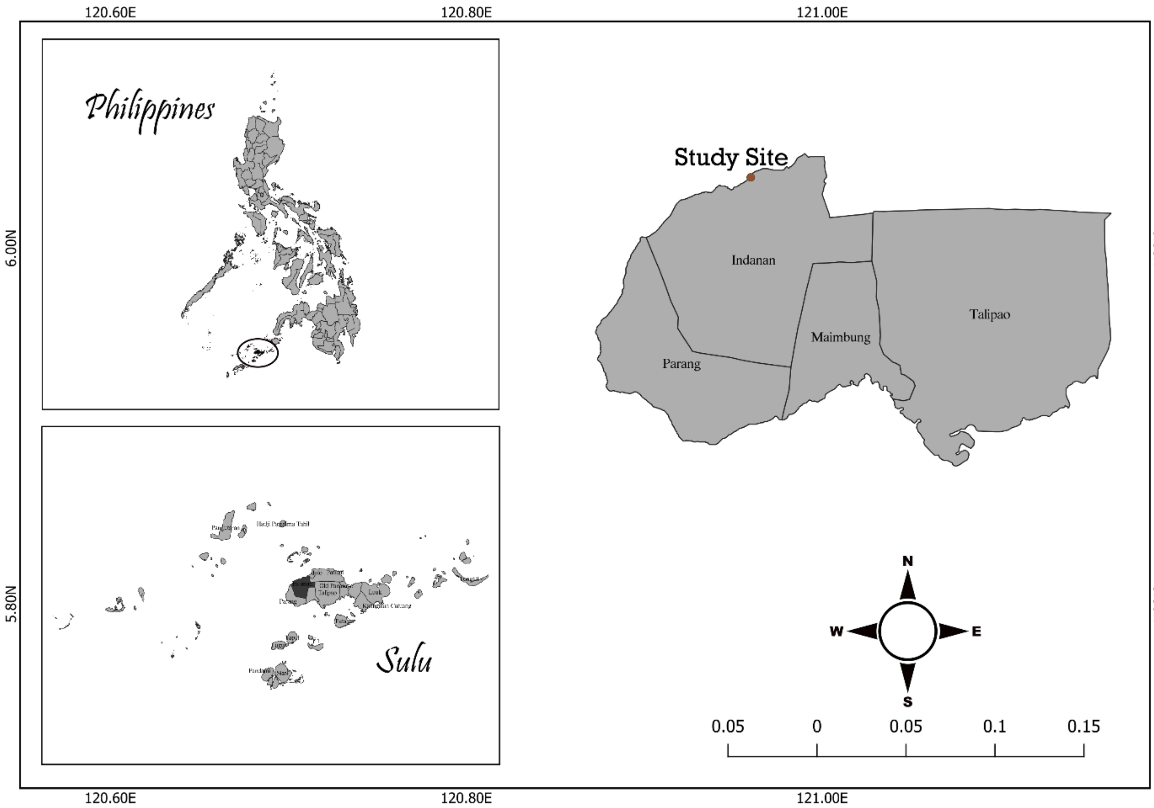

Figure 1. Map showing the study site.

2.2. Source of Crab Seed

Mangrove crabs in good and healthy condition, weighing 100 to 110 grams without broken legs and chelate (Figure 2), were collected from the wild and purchased from Maimbung public market, Sulu, Philippines.

Figure 2. Experimental animals.

2.3. Experimental design

This study was conducted under a completely randomized design (CRD). Twelve (12) modified plastic cages measuring 17 x 24.5 x 6 cm were coupled together and used as individual compartments. A total of six (6) cages are divided into each treatment. To avoid dis alignment of the coupled cages, nylon locks were used to secure the modified plastic cages, joined by haft (1/2) inch blue PVC pipes and by PVC (polyvinyl chloride) elbows at the corners. The two treatments were conducted using joint-coupled cages (Figure 3).

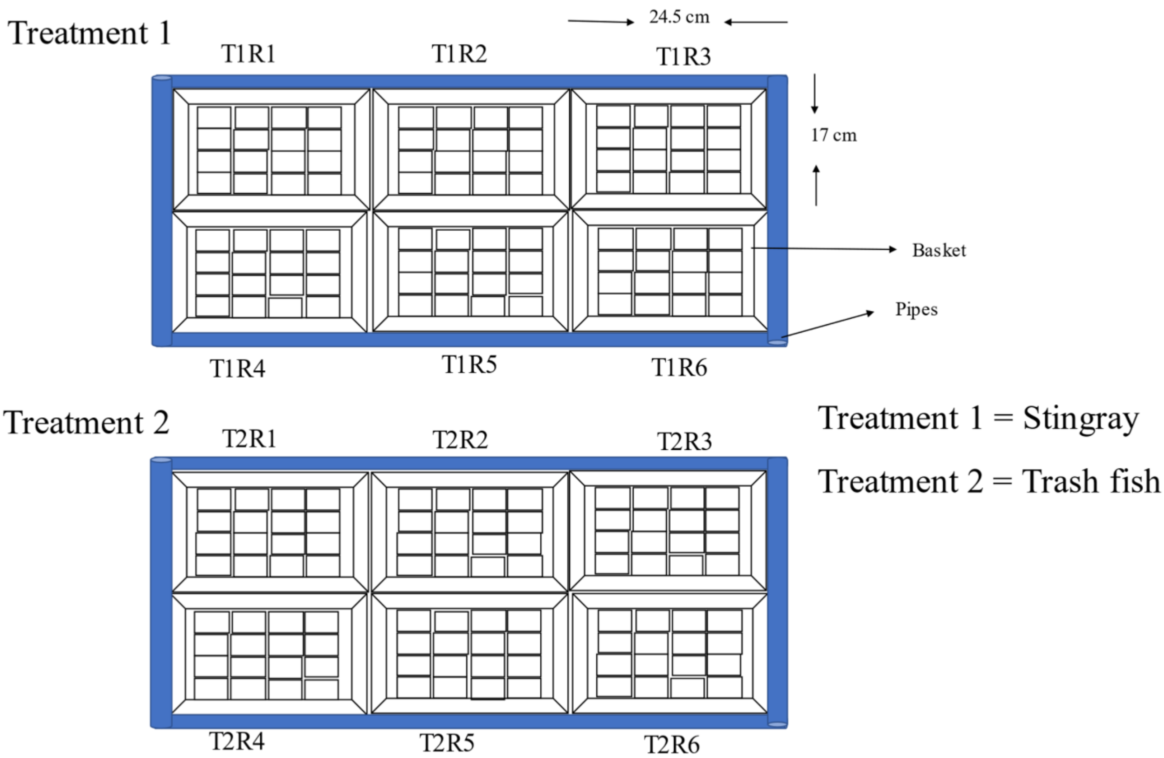

Figure 3. Experimental Design.

2.4. Feeding

The feeds used in the experiment were stingray (*Taeniura* sp.) and trash fish (*Sardinella* sp.). Afterward, the trash fish and stingray were cut up into smaller pieces, washed with clean water, and stored in the refrigerator to maintain their freshness. Feeding was done twice a day in the morning and afternoon at a rate of 10% of the average body weight.

2.5. Growth and Survival Sampling

Every crab was harvested and weighed using a weighing scale. Sampling was conducted after every ten days of fattening. A specific growth rate (SGR) was calculated at the end of the study to express the growth. SGR and survival rate were determined using Romano and Zeng (2006).

$$SGR=\frac{\ln (Wf)-\ln (Wi)}{\text{Days of culture}}\times 100$$

Where:
Wf = final weight
Wi = initial weigh

$$\text{Survival rate}=\frac{\text{Final number of samples}}{\text{Initial number of samples}}\times 100$$

2.6. Data Analysis

An independent sample *t*-test was carried out to test the significant differences between the mean weights, SGRs and survival rates of two treatments using IBM SPSS software version 20. The level of significance used in the study was 0.05. Data were presented as mean ± SE (standard error).

3. Results and Discussion

The SGRs of mangrove crab *S. serrata* of Treatment 1 (stingray) and Treatment 2 (trash fish) were 1.0 ± 1.03 % day^{-1} and -0.56 ± 0.88 % day^{-1}, respectively, on day 10 of the fattening period (Figure 4). Analysis showed no significant difference ($p>0.05$) between treatments. At day 20, SGRs of Treatment 1 (0.61 ± 0.52 % day^{-1}) and Treatment 2 (-41 ± 0.53 % day^{-1}) were not significantly different ($p>0.05$). The SGRs of Treatment 1 and Treatment 2 were 0.25 ± 0.20 % day^{-1} and –0.70 ± 0.27 % day^{-1}, respectively, at 30 days. Analysis revealed that Treatment 1 was significantly different ($p<0.05$) than Treatment 2. In addition, the mean weight value of mangrove crabs fed with stingray and trash fish were 166.67 ± 15.22 g and 106.67 ± 22.01 g (Figure 5). Crabs fed with stingrays performed significantly better ($p<0.05$) than crabs fed with trash fish as early as 15 days of the fattening period. However, they were not significantly different ($p>0.05$) at the end of the fattening period. Moreover, the survival rate of Treatment 1 (66.67 ± 21.08 %) did not significantly differ from Treatment 2 (66.67 ± 21.08 %) (Figure 6).

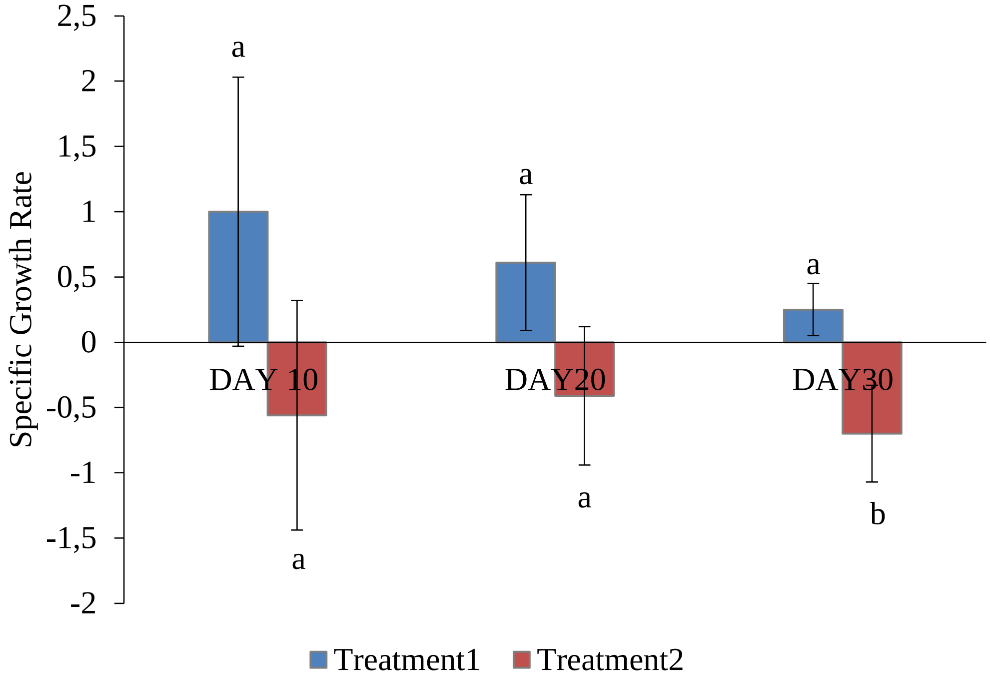

Figure 4. The SGR of mangrove crab (*S. serrata*) (T_1= Stingray, T_2=Trash fish) fattened in modified plastic cages for every sampling period. Bars with the same letters are not significantly different, while bars with different letters are significantly different.

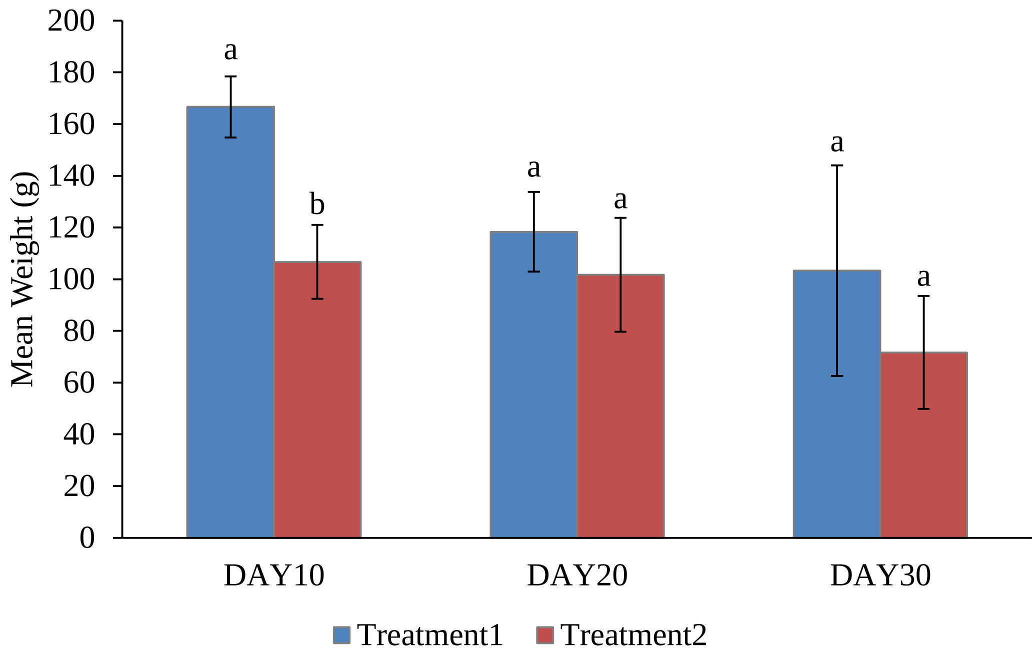

Figure 5. The mean value of mangrove crab (*S. serrata*) (T_1= Stingray, T_2=Trash fish) fattened in modified plastic cages for every sampling period. Bars with the same letters are not significantly different, while bars with different letters are significantly different.

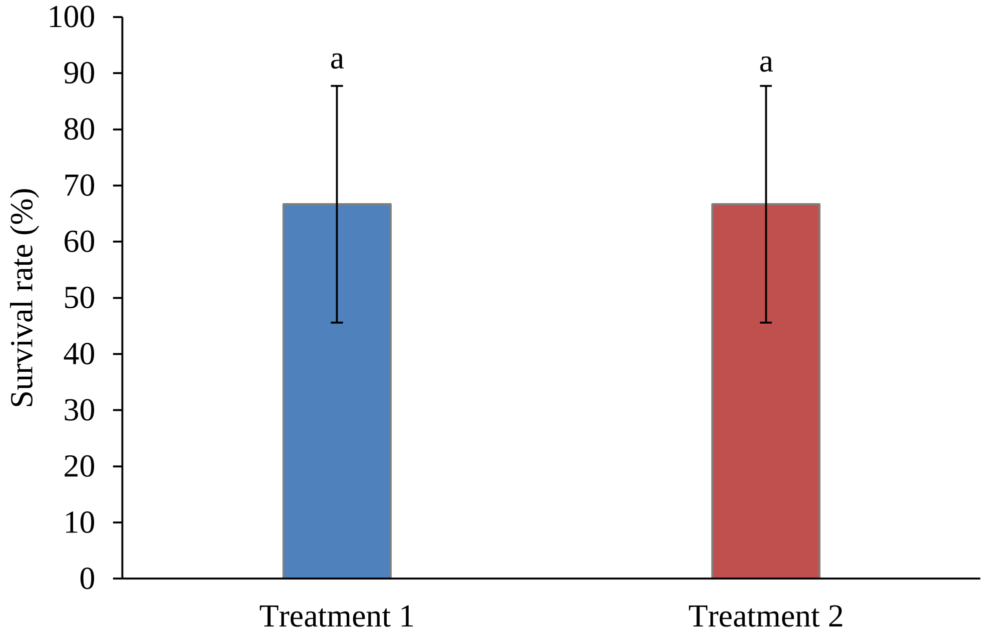

Figure 6. The survival rate of mangrove crab (*S. serrata*) (T_1= Stingray, T_2=Trash fish) fattened in modified plastic cages after 30 days. Bars with the same letters are not significantly different.

The fattening of mud crabs provides humans with an important food with protein, essential minerals, and energy, while the shells can serve as an alternative source of protein for animals (Islam et al., 2022). Moreover, this technology provides fishermen with another source of income aside from fisheries, which is indeed economically feasible in practice. The inherent tendency of crabs to escape the farm during culture is one of the most important problems associated with mangrove crab farming. It is necessary to employ a variety of management measures to prevent crabs from escaping the pond or cages, such as fencing and effective feeding schedules (Anil and Suseelan, 2001). In the present study, mangrove crab *S. serrata* was reared for 30 days in modified plastic cages fed with stingrays and trash fish. Results revealed that crabs fed with stingrays improved their growth as early as ten days; however, it did not significantly differ at the end of the culture period, suggesting that stingrays can be used as a source of food for the fattening of mangrove crabs *S. serrata*. In addition, *S. serrata* fed with both trash fish and stingrays did not affect its survival performance after 30 days. A stingray's nutritional value is similar to that of small native fish, in which smaller specimens are used as animal feed, fertilizer for fish ponds, and human consumption as well (Uddin et al., 2018). Furthermore, the growth of *S. serrata* fed with trash fish was lower after 30 days of culture in the present study. Similar results were found in the study of Oluwole et al. (2020), where the land crab *Cardiosoma armatum*, grows less after being fattened for three (3) months with trash fish. The report also found that the mangrove crab *S. oceanica* was inferior in terms of growth after 45 days of fattening on trash fish (Anil and Suseelan, 2001). In studies involving brown mussel flesh and fish caught bycatch, researchers found that brown mussel flesh resulted in higher mean final weights for male mangrove crabs (Triño and Rodriguez, 2001). Despite this, specifically, growth rate, carapace width, carapace length, and survival were not significantly different between the treatments after 30 days of fattening. This is consistent with the results obtained by Anil and Suseelan (2001), who fed mud crab with trash fish and clam meat for 60 days and observed comparable growth. On the contrary, using trash fish as feed for mangrove crabs increased the feeding rate by 10-15% of body weight (Cholik and Hanafi, 1991). It has been found that larvae produced from *S. olivacea* broodstocks fed trash fish contain high levels of most essential fatty acids (Herlinah and Septiningsih, 2015). Furthermore, the crab often shows negative growth after losing claws or limbs, which could be due to energy redistribution in the body, loss of foraging opportunities, or a reduced opportunity to feed (Drew et al., 2013). Natural declawing of crab claws occurs when stressed or threatened, and the crabs that have been manually declawed exhibit behavior that indicates a conscious awareness of the wounds, such as touching and shuddering or shielding the wounds with the remaining legs (McCambridge et al., 2016). Declawing altered the feeding habits of the crabs in controlled experimental settings, resulting in weight loss after the crabs consumed the same amount of food (Davis et al., 1978; Patterson et al., 2009; Duermit et al., 2015). In the present study, mangrove crab *S. serrata* may be affected by the sound of the boat engine produced near the mangrove area of cultivation, which may be the reason why they became stressed, disintegrated the chelipeds, and developed weight loss in both treatments. In addition, there is evidence that actual crabs can be stressed and dangerous as a result of noise pollution (Weilgart, 2018). Researchers stated that stress levels rose in crabs when artificial sounds like cruise ships and giant oil tankers were present (Slabbekoorn et al., 2010; Carter, 2019).

4. Conclusion

The fattening of mangrove crab *Scylla serrata* fed with stingray was better in growth performance during the early ten days, but the superiority disappeared after 30 days. On the other hand, the crab growth was affected by uncontrollable factors such as cheliped disintegration, which led to reduce crab growth. However, the results might be useful to the mangrove crab fatteners due to stingrays' ability to improve crab growth more than trash fish. In addition, the study’s results need to be validated for future research.

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